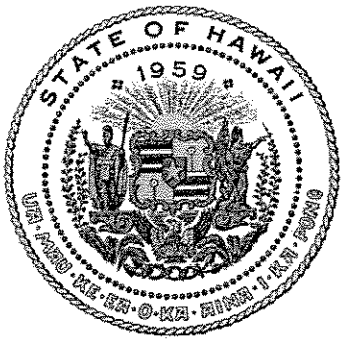

Public Utilities Commission

State of Hawaii

Electric Utility Rate Design in Hawaii: An Initial Concept Paper

November 1, 2004

Executive Summary

The Hawaii Public Utilities Commission ("Commission") has a legislative mandate to formulate an electric utility rate design that meets at least four criteria by December 31, 2006. First, the rate design must enable the achievement of renewable portfolio standards ("RPS") requiring that renewable energy resources are to have a specific share in the power generation mix by a particular period of time. Second, the rate design must encourage investments in renewable energy facilities. Third, the rate design must conform to the existing regulatory regime, which is cost-of-service regulation, or to alternative regulatory regimes, such as performance-based ratemaking ("PBR"). And fourth, the rate design has to provide utilities an opportunity to earn a reasonable rate of return.

The objective of this Initial Concept Paper is to summarize the Commission's methodology of fulfilling its legislative mandate. The Commission, employing a collaborative workshop approach, plans to hold three workshops encouraging public discussion of its work-in-progress. The goal of the first workshop, scheduled for November 22 and 23, 2004, is to describe and gather comments on the Commission's methodology as a whole. The Commission offers this Initial Concept Paper as a starting point for discussions at the initial workshop. The goal of the second workshop, planned for February or March 2005, is to describe and gather comments on the key factors driving successful RPS schemes and PBR regimes as well as on their use as inputs to the design of electric utility rates in Hawaii.

The goal of the third workshop, planned for May or June 2005, is to describe and gather comments on the simulation of the power market in Hawaii incorporating, as discussed in the prior workshops, the lessons learned on electric utility rate design under various RPS schemes and PBR regimes, as well as on its use as a tool for electric utility rate design in Hawaii. The simulation is performed with the use of computer models embodying optimization methods that reflect the technical and commercial features of each island power market in Hawaii and the State as a whole. It explicitly accounts for the RPS of Hawaii, the encouragement of investments, existing and alternative regulatory regimes, and the utilities' opportunity to earn a reasonable rate of return through the rate case process.

Candidate rate designs are evaluated through several simulations that assume various scenarios for cost-of-service regulation and alternative incentive regimes, such as PBR. The evaluation of the candidate rate designs will include a consideration of the incentive properties documented from current and best practices of RPS schemes and PBR regimes, social welfare implications, and efficiency and equity effects. The optimal electric utility rate design chosen from the analysis is intended to fulfill the Commission's legislative mandate and achieve the maximum social welfare.

The Commission envisions that the end result of all the analysis discussed in this Initial Concept Paper and at the scheduled and planned workshops will be a document that forms the basis of a set of rules to be adopted in a conventional rulemaking process to follow, providing input to the Commission's decisions on electric utility ratemaking.

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I. Introduction

A. Legislative Mandate of the Commission

1. The prime purpose of the Hawaii Public Utilities Commission ("Commission") is to ensure, in an efficient, fair, and impartial manner, that regulated utilities safely and efficiently provide adequate and reliable services at just and reasonable rates, and that they have an opportunity to earn a reasonable rate of return.[1] One of the stated long-term goals of the Commission is to promote and encourage renewable sources of power generation in order to increase the reliability, sustainability, and efficiency of electricity supply.[2]

2. The Hawaii Legislature asserts that the development of renewable energy resources can potentially reduce dependence on imported oil, contribute to energy security, protect the environment, and create jobs; that incentives may be needed to promote the development of renewable energy resources; and that such incentives can be included in the utility rate structure.[3] Act 95, Session Laws of Hawaii 2004, among other things, requires the Commission to perform the following Legislatively Mandated Tasks:[4]

   - By December 31, 2006, develop and implement a utility ratemaking structure that may include but is not limited to performance-based ratemaking ("PBR"), to provide incentives encouraging Hawaii's electric utilities to use cost-effective renewable energy resources found in Hawaii to meet the renewable portfolio standards ("RPS") established in Section 269-92, while allowing for deviations from the standards in the event that the standards cannot be met in a cost-effective manner, or as a result of circumstances that could not have been reasonably anticipated or ameliorated and are beyond the control of the utility; and

   - Gather, review, and analyze data to determine the extent to which any proposed utility ratemaking structure would impact electric utilities' profit margins, and to ensure that these profit margins do not decrease as a result of the implementation of the proposed rate structure.[5]

3. In summary, therefore, the Commission has a legislative mandate by December 31, 2006 to formulate an electric utility rate design that:

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[1] See Public Utilities Commission, State of Hawaii, *Annual Report Fiscal Year 2002-03*, December 2003, at 4.

[2] *Ibid.*

[3] See The Senate, Twenty-second Legislature 2004, State of Hawaii, S. B. No. 2474, at 1-4.

[4] Act 95 also requires that the Commission (1) Contract with the Hawaii Natural Energy Institute of the University of Hawaii to conduct independent studies to be reviewed by a panel of experts; (2) Revise the standards based on the best information available at the time if the results of the studies conflict with the renewable portfolio standards established by Section 269-92; and (3) Report its findings and revisions to the renewable portfolio standards based on its own studies and those contracted to the legislature no later than twenty days before the convening of the regular session of 2009, and every five years thereafter.

[5] The Commission will seek an amendment to the legislation to remove the requirement that the Commission ensure that electric utilities' profit margins do not decrease, but to affirm that the opportunity of electric utilities to earn a reasonable rate of return shall not be diminished as a result of the implementation of the proposed rate design.

- Enables the achievement of the RPS cost-effectively;
- Encourages investments in renewable power generation in Hawaii;
- Conforms to existing or alternative regulatory regimes, such as PBR; and
- Provides utilities with an opportunity to earn a reasonable rate of return through the rate case process.

B. Approach of the Commission: Collaborative Workshops

4. The Commission has selected a collaborative workshop approach encouraging public discussion of its work-in-progress. The Commission observes that the successful design and implementation of regulation seem to result from balanced, open, and inclusive discussions in the form, for example, of collaborative workshops. A series of workshops involving stakeholders is likely to facilitate the identification of key issues and the development of appropriate policies that are expected to enjoy broad support. It also provides the Commission with an opportunity to articulate its vision for regulatory policy in Hawaii.

5. The Commission plans to hold three (3) two-day workshops: the first on November 22 and 23, 2004, the second, in February or March 2005, and the third, in May or June 2005. Three to four weeks before each workshop, the Commission will publish a paper describing its approach, along with actual or expected results, and inviting stakeholders to provide written comments. The deadline for the submission of written stakeholder comments is one or two weeks before the workshop. Prior to each workshop, the Commission will publish a schedule describing a sequence of presentations and panel discussions at the workshop.

   - The goals of the first scheduled workshop are to describe and gather comments on the Commission's methodology in fulfilling its legislative mandate. The Commission is publishing this Initial Concept Paper as an instrument for opening the channels of communication before the workshop and for initiating discussions at the workshop itself.
   - The goals of the second planned workshop are to describe and gather comments on the key factors driving successful RPS schemes and PBR regimes as well as on their use as inputs to the design of electric utility rates in Hawaii.
   - The goals of the third planned workshop are to describe and gather comments on the simulation of the power market of Hawaii as well as on its use as a tool for electric utility rate design in Hawaii.

6. In Paragraph 11 below, the Commission issues an invitation to provide written comments on this Initial Concept Paper. In preparation for the first workshop on November 22 and 23, 2004, the Commission plans to gather any written comments, analyze them, and develop a program of presentations and panel discussions at the workshop. Before the workshop, the Commission also plans to suggest speakers and panelists who may give presentations at the workshop, and to invite them accordingly.

7. The Commission envisions that the end result of all the analyses discussed in this Initial Concept Paper and at the scheduled and planned workshops is a document that forms the basis of a set of rules for electric utility ratemaking, to be adopted in a conventional rulemaking process. The Commission expects to use the formally adopted rules to implement the RPS pursuant to its legislative mandate.

8. The Commission is using the services of Economists Incorporated ("EI"), http://www.ei.com, an economic consulting firm composed of 36 economists in Washington DC and the San Francisco Bay Area in California. The EI economists hold graduate degrees from top tier universities. Most have doctorates, and many were previously employed at one or both of the two federal antitrust agencies, the US Department of Justice Antitrust Division and the Federal Trade Commission.

   - EI specializes in economic analysis and litigation support for matters involving the operation of markets, pricing and utility ratemaking, policy analysis, and commercial damages, among others. EI economists have consulted for utilities, energy companies, their counsel, and Federal and State regulators on power system modeling and simulation, generator facility valuation, tariff design, optimal resource procurement, utility finance, rate cases and the cost of capital, contract disputes, and "but-for" and policy analysis, among others. EI economists have deep capabilities in the design, implementation, and use of electric power optimization models and the associated utility financial analysis.

   - Manny A. Macatangay, Senior Economist, is leader of the EI engagement team assisting the Commission. Mr. Macatangay has a doctorate in electricity economics from the University of Manchester, UK and completed a Post-doctoral Fellowship at the University of California Energy Institute, Berkeley. He studies competition and regulation in energy markets and related sectors. He has testified at trial in the US Court of Federal Claims in Washington DC on long-run conditions of energy markets, the prospects for nuclear power generation, and electric power simulation models. Mr. Macatangay has published in the *European Journal of Law and Economics*, *Utilities Policy*, *Electricity Journal*, *Energy Policy*, the *Journal of the Asia Pacific Economy*, *Private Antirust Litigation News of the American Bar Association*, the *Environmental Monitor*, *Economist Ink*, and other periodicals.

   - Schyler M. Thiessen, Vice President, holds a Master's Degree in Financial Engineering from Haas Business School, UC Berkeley. Mr. Thiessen specializes in risk measurement and management, and has extensive experience in financial and economic analysis, statistical modeling, and business and securities valuation. He has performed financial simulation modeling, reviews of debt covenant agreements, and industry performance comparisons in order to re-create financial operations and statements under various contract and payment scenarios. Mr. Thiessen holds several industry accreditations: Financial Risk Manager, Global Association of Risk Professionals; Certified Financial Manager, Institute of Management Accountants; and Accredited Valuation Analyst, National Association of Certified Valuation Analysts.

   - Mr. Macatangay and Mr. Thiessen enjoy the support of two EI Principals: Stephen E. Siwek and John R. Morris. Mr. Siwek has an MBA from George Washington University. He is a specialist in financial and cost analysis and has particular expertise in the economic analysis of regulated utilities, such as telecommunications, electric, gas, and postal service providers. He has testified as an expert witness in more than forty proceedings before Federal and State regulatory

authorities. Mr. Morris has a doctorate in economics from the University of Washington. He studies competition in the electric power and natural gas industries, and has testified before the Federal Energy Regulatory Commission, State commissions, and in Federal court. He is an expert on computer simulation models, and is currently Chair of the Antitrust Committee of the Energy Bar Association.

C. Objective and Scope of the Initial Concept Paper

9. The objective of this Initial Concept Paper is to summarize the Commission's methodology of fulfilling its legislative mandate. The Commission's legislative mandate to implement the RPS affects the tools of regulation. Regulatory tools can generally be classified into three: rate design, regulatory regime, and contractual obligations.

   - The design of an electric utility rate deals with the structure and level of prices. An efficient rate structure encourages prudent usage, recovers all relevant costs, and promotes the appropriate scale, timing, and location of investment. The legislative mandate specifically requires the Commission to design an electric utility rate structure.

   - Regulatory regimes provide incentives in one form or another, and there are generally three types of regulatory regimes. Cost-of-service or rate-of-return regulation puts an upper limit on the mark-up allowed on costs that may be recovered and a reasonable return on investment. Price or revenue caps, which are examples of what is commonly called incentive regulation, put an upper limit on either the rates potentially charged or the revenue potentially earned by the utility. A hybrid regime is an intermediate approach that, for example, provides either a guaranteed reimbursement to a cap regime or additional incentives to a cost-of-service regime. The legislative mandate requires the Commission to consider existing or alternative regulatory regimes for electric utility rate design in the context of the rate case process.

   - There are generally three types of contractual obligations. Investment obligations increase the likelihood of achieving a particular regulatory goal. Quality level obligations increase the likelihood of meeting performance standards. Contract duration and termination obligations increase the likelihood of completing investments in a timely and appropriate manner. The legislative mandate specifically requires the Commission to enable the achievement of the RPS through an electric utility rate design that would encourage investments in renewable power generation in Hawaii.

10. Part II explains the Commission's approach to the analysis of regulation under RPS in Hawaii and other jurisdictions. Part III explains the Commission's approach to the analysis of regulation under PBR in Hawaii and other jurisdictions. Part IV describes the Commission's approach to the computer modeling of the Hawaii electric power market and its constituent utilities, entities, and islands. Part V outlines the Commission's approach to the design of an electric utility rate that maximizes social welfare and satisfies the Commission's legislative mandate.

D. An Invitation to Comment on the Initial Concept Paper

11. The Commission invites stakeholders to provide written comments on this Initial Concept Paper. Please send written comments by 10:00 a.m. on Monday, November 15, 2004 to Catherine P.

Awakuni, Commission Counsel, Public Utilities Commission, 465 South King Street, Room 103, Honolulu, HI 96813, Fax (808) 586-2066, E-mail Catherine.P.Awakuni@hawaii.gov. Comments may focus on the issues outlined in the following paragraphs:

- Paragraph 21
- Paragraph 29
- Paragraph 40
- Paragraph 46
- Paragraph 53
- Paragraph 58

II. Regulatory Framework Under RPS

A. Status and Prospects of Regulation Under RPS: An Overview

12. According to the U.S. Department of Energy ("DOE"), electricity generated from renewable resources in the U.S. is likely to increase steadily from 304 billion kWh in 2002 to 400 billion kWh in 2010, 420 billion kWh in 2015, 442 billion kWh in 2020, and 460 billion kWh in 2025.[6] An increase in the use of renewable energy seems to be highly beneficial to the economy and the environment. Supply uncertainty and price volatility of oil and other energy commodities, as well as pollution from fossil fuel use in power generation, figure prominently in policy debates.[7] The development of renewable energy resources, therefore, is expected to reduce dependence on imported oil, contribute to energy security, and protect the environment.

13. As a result of the oil crisis in the early 1970's, there has been a policy effort to encourage investments in renewable energy sources. One recent policy trend is the establishment of RPS requiring a specific share of renewable energy in the power generation mix by a particular period of time. The RPS is expected to encourage investments in renewable energy sources, such as solar and wind power, among others. However, the viability of renewable energy investments, which depends on a wide range of factors, has been a controversial topic.

- Solar energy facilities enjoy government subsidies in various forms, and whether or not a particular solar power project remains viable given a change, for example, in the structure of the overall subsidy program is likely to be an empirical question. There is an expectation that new technologies, such as nanotechnology allowing solar panels to be thin and pliable enough to be rolled in sheets, potentially can reduce the cost and increase the efficiency of solar panels.[8] Nanotechnology solar panels, depending on their size, are portable and can be placed in a wide variety of locations. The efficiency of solar cells and panels is said to have improved dramatically due to early nanotechnology applications.

- Wind power facilities entering service by December 31, 2003 enjoy a tax credit, $0.018/kWh in the first 10 years of operation, and the Energy Policy Act of 2003 had planned not only to extend the eligibility period to 2006 but also to include solar power and other renewables.[9] Although advances in turbine technology have reportedly increased the efficiency of wind power generation, the tax credit seems to be crucial to the prospects of winning financing for new projects. A major barrier to the acquisition of project financing appears to be the unpredictability of the wind regime that

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[6] See Energy Information Administration, *Annual Energy Outlook 2004*, January 2004, at 145. Renewables include conventional hydroelectric, geothermal, wood, wood waste, municipal solid waste, landfill gas, other biomass, solar, and wind power.

[7] See for example The Economist, "Clouded," in US Election 2004: A Special Briefing, October 9, 2004, at 30-1; The Economist, "Crude Arguments," October 9, 2004, at 77-8; and The New Yorker, "Pump Dreams," October 11, 2004, at 42-3.

[8] See Department of Energy, *Photovoltaics Technology Plan*, http://www.nrel.gov/docs/fy03osti/29381.pdf last visited on November 1, 2004.

[9] *Supra* Note 6 at 27.

primarily determines the amount of electricity generated. For these types of energy projects, financing is serviced through revenues generated by the projects themselves, and recourse is usually confined to project assets.

14. The current outlook for renewable energy seems to be cautiously optimistic. The DOE forecasts that, with rising gas prices, renewable energy sources, especially biomass, wind, and geothermal, are becoming competitive with new gas-fired plants in many parts of the U.S.[10] The DOE also forecasts that, although the RPS is likely to encourage renewable energy capacity additions in several States, solar power is not expected to make significant contributions to the grid through 2025.[11] FPL Energy American Wind, in what is reported as the first project financing for wind power in the U.S., issued 20-year secured limited recourse bonds to construct seven wind farms in six states.[12] The DOE forecasts that, with the tax credit and assuming a 20-year financial project life, the levelized cost of wind plants entering service by 2006 is between $0.045/kWh and $0.057/kWh, which makes it competitive with new gas-fired and new coal-fired plants.[13]

B. Status and Prospects of Regulation Under RPS: The U.S. Experience

15. Several states either have started or are planning RPS. The states that have adopted RPS are Arizona, California, Connecticut, Hawaii, Iowa, Maryland, Maine, Massachusetts, Nevada, New Jersey, New York, New Mexico, Pennsylvania, Rhode Island, Texas, and Wisconsin. Illinois and Minnesota have voluntary renewable energy goals or RPS-style legislation without enforcement provisions.[14]

16. California, one of the leaders in RPS, plans to obtain 20% of its energy from renewable resources by 2017.[15] Under the RPS, the California Public Utilities Commission is exploring the possibility of creating tradable renewable-energy credits, including credits from customer-owned distributed generation facilities. To encourage the development of renewable power from distributed generation, the California Public Utilities Commission reportedly announced that utilities could count the distributed generation developed by their customers as part of the renewable power they must acquire to comply with the RPS under California law.

17. One factor possibly affecting the viability of renewable energy is whether or not negative externalities associated with fossil fuels are properly quantified and priced. An interesting hypothesis to test is that

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[10] *Supra* Note 6 at 57 and 85.

[11] *Supra* Note 6 at 85-6.

[12] See http://www.whitecase.com/news/news_detail.aspx?newsid=10308&type=Newsmakers last visited on November 1, 2004. Bonds secured against wind power involve complex financial instruments and account for unusual land ownership and use issues and environmental regulations.

[13] *Supra* Note 6 at 60.

[14] See http://www.repp.org/rps_map.html last visited on November 1, 2004.

[15] See State of California, *Energy Action Plan*, 2003, at 5 (http://www.cpuc.ca.gov/word_pdf/REPORT/28715.pdf last visited on November 1, 2004).

renewable energy could be competitive to fossil fuels if environmental externalities are taken into account, for example, through carbon taxes or pollution levies. Some renewables, notably solar power, seem to be viable only in high priced wholesale markets, under sole-source retail arrangements for large users or user groups, or with subsidies, among others. One possible role of regulatory policy, perhaps through the RPS, is to stimulate a virtuous cycle of investments in renewable energy facilities, technological change, the emergence of renewable energy commodities, the formulation of creative commercial and pricing arrangements, and the use of innovative financial instruments.

C. Status and Prospects of Regulation Under RPS: The Hawaii Experience

18. Petroleum and coal are the dominant fuels for power generation in Hawaii. In 2002 the share of oil-fired plants in the capacity mix was 80%, and that of coal-fired plants, 9%.[16] Under the RPS regime of Hawaii, the share of renewable energy resources is legislatively required to increase from 6.6% in 2002 to 10% in 2010, 15% in 2015, and 20% in 2020.[17] In Hawaii, the average retail price of electricity, $0.1339/kWh, was the highest in the US in 2002,[18] and the effective residential rates of most utilities exceeded $0.20/kWh in 2003.[19] Among all the states in 2002, Hawaii ranked 22nd, 21st, and 19th in per square mile emissions of sulfur dioxide, nitrogen oxide, and carbon dioxide, respectively.[20]

19. The RPS in Hawaii is anticipated to reduce power prices, contribute to energy security, and protect the environment. It seems crucial for an investor in renewable energy to account for all costs relevant to the specific location of the facility in Hawaii. This allows an accurate comparison to be made between the landed cost of conventional fuels in Hawaii and the locational cost of renewably energy.

D. A Comparison of the Hawaii Experience to Best Practices Elsewhere

20. The Commission needs to review the various alternatives for renewable energy resources, and to determine the potential, through RPS, for encouraging investments in renewable energy resources. The Commission plans to identify the key factors driving a successful RPS scheme in the U.S., and to use them as inputs to the design of electric utility rates in Hawaii.

21. The Commission welcomes comments on the various issues discussed above:

- Status and prospects of regulation under RPS in Hawaii and elsewhere;
- Various alternatives for renewable energy resources in Hawaii;

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[16] State Electricity Profiles 2002, http://www.eia.doe.gov/cneaf/electricity/st_profiles/hawaii.pdf last visited on November 1, 2004.

[17] *Supra* Note 3 at 10.

[18] *Supra* Note 16.

[19] *Supra* Note 1 at 53.

[20] *Supra* Note 16.

- Viability of renewable energy investments;
- Locational cost of renewable energy in Hawaii; and
- Successful RPS schemes and electric utility rate design.

III. Regulatory Framework Under PBR

A. Status and Prospects of Regulation Under PBR: An Overview

22. Regulation may be viewed as the vanguard of social welfare maximization representing a robust intellectual anchor, and customer-focused regulation can yield efficient outcomes securing the long-term maximization of social welfare. PBR, a form of incentive regulation, allows a portion of the cost savings to flow back to the utility. It provides for a package of rewards and penalties on the basis of the achievement of specific performance measurements, such as reliability and adequacy of service, customer service quality, or fuel use efficiency, among others.

23. Regulation is among several risk factors that utilities take into account. Clear and consistent regulatory policy provides a stable business environment conducive to efficient operation and expansion. Capital generally flows to activities with the highest returns, and financing is crucial to the fund-raising efforts and long-term viability of utilities striving not only to exceed national and international standards of performance but also to meet the investment requirements under RPS. Wall Street now looks favorably at regulated utilities that are widely viewed to have low risks and a steady cash flow.

B. Status and Prospects of Regulation Under PBR: The U.S. Experience

24. Incentive regulation, of which PBR is an example, seems to have been in existence for nearly a century. Sliding-scale incentives were reportedly applied as early as 1906, and regulators installed targeted incentive programs, some focused on specific power plants, in the 1970's and 1980's. There are several types of incentive regulation and PBR, such as rate case moratoria, price caps, and incentives related to fuel, generation mix, demand response, and service quality. The recent history of PBR is closely connected to that of power sector restructuring and deregulation. Thus, some of the effects of PBR may be indistinguishable from those of competition.

25. Recent assessments have concluded that the design of a PBR regime requires a huge effort by all stakeholders. The formulation of an appropriate productivity index may entail complex and contentious analysis of costs and operations. A price cap promoting price stability may unintentionally discourage energy efficiency investments. In the event a combination of PBR regimes is needed, the number of combinations may be large, and the analysis of alternative combinations may be unwieldy. In short, prudence and perspective in the implementation of a PBR regime are key.

C. Status and Prospects of Regulation Under PBR: The Hawaii Experience

26. The Commission appears to be properly positioned to explore the prospects of PBR. One of the stated short-term goals of the Commission is to modernize the regulatory process whenever reasonably feasible in order to increase the efficiency of the Commission and regulated utilities.[21] At the moment, the Commission performs its regulatory role in a variety of ways:

- Cost-of-service regulation embodied in the rate case process;

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[21] *Supra* Note 1 at 4.

- Approval of purchases, integrated resource plans, interconnection standards, power purchase agreements, connection and attachment agreements, capital improvement projects exceeding $2,500,000, and financing arrangements, among others;

- Investigation and resolution of complaints;

- Required submissions of financial reports;

- Required payments of public utility revenue fees;

- Monitoring of service quality and publication of service reliability indices;

- Approval of a demand-side management programs involving shareholder incentives; and

- Investigations of emerging regulatory issues, such as RPS, distributed energy resources, and competitive bidding for new generation capacity, among others.

27. The Commission is exploring the prospects for PBR independent of any plan to restructure and deregulate the power sector in Hawaii. Power sector restructuring and deregulation in Hawaii seem to be controversial topics. The absence of interconnection among utilities and islands and the small size of the State's utility systems are reportedly two key barriers to restructuring and deregulation. If a PBR regime is designed and implemented in Hawaii in the foreseeable future, then one key assumption will be that power sector restructuring and deregulation are unlikely to occur in the short run.

D. A Comparison of the Hawaii Experience to Best Practices Elsewhere

28. The Commission needs to review alternative PBR regimes and to determine their potential for encouraging investments in renewable energy resources. The Commission plans to identify the key factors driving a successful PBR regime in the U.S., and to use them as inputs to the design of electric utility rates under a potential Hawaiian PBR regime.

29. The Commission welcomes comments on the various issues discussed above:

- The impact of regulation on the behavior of utilities;

- Status and prospects of regulation under PBR in Hawaii and elsewhere;

- Alternative regulatory regimes available;

- Regulation and power sector restructuring in Hawaii; and

- Successful PBR regimes and electric utility rate design.

IV. Power Market Simulation

A. Overview

30. The Commission plans to simulate the power market of Hawaii using computer models incorporating the lessons learned on electric utility rate design under various RPS schemes and PBR regimes. The simulation is at the heart of the Commission methodology described in this Initial Concept Paper. It comprehensively covers and simultaneously analyzes the issues specifically identified in the Commission's legislative mandate.

- The RPS is pre-determined through legislation and taken as a given. It is treated as an exogenous independent variable in the models.

- Investments in renewable energy generation capacity at the optimal scale, timing, and location are endogenously determined in the hourly simulation representing the real time operations of the power market.

- Existing or alternative regulatory regimes, such as PBR, are pre-determined from current or best practice and treated as exogenous policy variables in the models.

- The electric utility rate design is the dependent variable endogenously determined in an annual simulation replicating the rate case process and any regulatory lag.

- The financial structures of the utilities are endogenously determined in an annual simulation reflecting not only an opportunity to earn a reasonable rate of return but also the financial consequences of deviations, if any, from the RPS.

31. The simulation models deploy optimization methods that reflect the technical and commercial features of each island power market in Hawaii. They capture a variety of engineering and economic relationships, such as load forecasts, demand response, generation, fuel, the optimization of generation and transmission capacity additions, capital expenditures, rate structures, utility financial structures, and the rate case process, including the effects of any regulatory lag.

- The load model determines current and forecast consumption for each rate class per utility. It uses data on areas, class profiles, daily load shapes, direct load control programs, load classes, load groups, and seasonal ramp-up patterns, among others.

- The generation and fuel model performs an optimal dispatch of generation resources. It uses data on capacity deration, capacity segments, cost curves, off-system marginal energy cost, seasonal marginal cost curves, fuel contracts, fuel types, hydro capacity, hydro units, system or utility trading partners, maintenance cycles, system marginal cost curves, thermal units, pumped storage units, seasonal fuel costs, segment thermal unit capacity, segment emissions, segment heat rate, non-thermal resources, transactions or contracts, contract paths, transaction curves, transmission limits, transmission links, transmission losses, unit type, and water years, among others.

- An investment model optimizes the addition of plants and lines. It formulates least-cost expansion plans over the study period and consequently allows the selection of an optimal expansion plan among them. It uses data on alternative units, resources combined to form a single alternative, demand-side management programs, the number of states or investment conditions in each year, and the study period, among others.

- The financial model estimates the financial statements of each utility. It uses data on asset classes, classifications of individual plant expenses, common stock issues, administrative and general expenses, debt issues, leases, reserve funds, and interest rate schedules for preferred stock and long-term debt, among others.

- A capital expenditure and recovery model determines the financing of investments in plants and lines. It uses data on bond issues, construction-work-in-progress, depreciation schedule, project life, project classes, and project numbers, among others.

- A customer rate model estimates the rate level and structure for each customer and rate class per utility, given the revenue requirement and the rate case process, including any regulatory lag. It uses data on base rate schedules, rate classes, and annual or jurisdictional indicators for allocating plant and expense items to particular rate classes, among others.

- A system model includes calculations and data required by other models. It uses information on air basins, emissions, block intervals, block rate schedules, effluents, escalation rates, generation companies, historical customer distributions, rate schedules, seasons, time-of-use profiles, and the study period, among others.

32. The optimization models are hourly, the financial models are annual, and there is interaction between the hourly and annual models. The simulation proceeds in stages described below, and depending on the methodological challenges arising in the course of the runs, there could be iterations between one stage and another, or within stages.

33. In the course of its work, the Commission plans to submit information requests to utilities and other stakeholders for data and relevant materials that are inputs not only to the simulation models but also to the overall analysis. The Commission expects to receive the data and other relevant materials in a format that best facilitates its work. The Commission is likely to engage in close coordination with utilities and other stakeholders on the matter of information requests.

B. Baseline Simulation of the Power Market of Hawaii

34. The objective of a Baseline Simulation is to capture the current conditions of the power market of Hawaii for a particular base year, such as 2003 or 2004. The generation mix is the existing collection of power plants and supply resources. The profile and level of loads are the existing consumption patterns across residential, commercial, and industrial customers. The structure and level of prices are the existing rates for various customer classes under the current regime of cost-of-service regulation. The financial structures of the utilities reflect the existing opportunities for earning a reasonable rate of return according to their current or most recent rate case.

35. A Baseline Simulation is determined from the validity and stability of results after repeated runs. A simulation is valid if the results closely represent the current conditions of the power system, and is stable if the results do not change radically with additional runs.

    - The first step is to perform a test simulation capturing the essential elements of the power market in Hawaii. A test simulation puts special emphasis on price discovery across the system and is basically an examination of the model and the data. It replicates the market structures and protocols currently used, and ideally should yield results that "make sense."

    - The second step is to perform a calibration in order to make any necessary adjustments. Test simulation results are compared to actual flow data in order to determine the magnitude and scope of adjustments. Deviations from flow data are documented, and possibly used, together with expert opinion, as inputs to the calibration and in preparation for additional test simulations, if needed. A sensitivity analysis determines the bounds of the test simulation. Calibration ceases as soon as a reasonable stopping criterion, such as a comfortably small deviation from actual flow data, has been met, and an appropriate baseline scenario has been identified and adopted.

36. Hourly optimization models are used to analyze the engineering and economic relationships involving load, demand response, generation, fuel prices and supply, and the optimization of generation and transmission capacity additions. Generation resources are marshaled in increasing costs until load is fully met in each hour. The objective function of the optimization models is to meet load at lowest dispatch cost. In the absence of any demand elasticity, dispatch cost is the relevant measure of social welfare. In the presence of demand elasticity, which allows a downward sloping demand curve, the sum of consumer surplus and producer surplus constitutes the relevant measure of social welfare.

37. Annual financial models are used to analyze utility financial planning issues involving capital expenditures, rate structures, financial structures, and the rate case process, including the effects of any regulatory lag. Capital expenditures, relevant costs, and a reasonable rate of return determine the revenue requirement. The objective is to recover the revenue requirement through tariffs for customer classes in proportion, as much as possible, to the costs associated with them.

38. The hourly and annual models feed into each other. Results of the hourly model are aggregated for the base year and provide inputs to the annual model. Results of the annual model are fed back to the hourly model. The hourly and annual models interact until equilibrium in the base year is achieved.

39. The output of a Baseline Simulation is a replication of the existing engineering and economic relationships in the power market of Hawaii for a particular base year. It provides a meaningful starting point for further analysis involving future time periods.

40. The Commission welcomes comments on the various issues discussed above:

    - The simulation models;

    - Objective of the Baseline Simulations;

    - The choice of base year;

- Design of inputs; and

- Congruence between simulation outputs and market realities.

C. Simulation of the Status Quo: Cost-of-service Regulation

41. The objective of the Status Quo Simulation is to capture the operations of the power market of Hawaii over several future years, assuming the continuation of cost-of-service regulation. The study period can commence on the base year defined above and can terminate at the end of the project life of renewable (and non-renewable) power generation plants that would have been installed as part of the simulation. A typical study period could range from 20 to 30 years.

- The share of renewable resources in the generation mix is configured to satisfy the RPS regime under the Commission's legislative mandate. The RPS is a minimum but hard constraint on the future share of renewable resources to total electricity supply.

- The profile and level of loads are the future consumption patterns of residential, commercial, and industrial customers. Load forecasts can be developed through statistical methods.

- The structure and level of prices are the future rates for various customer classes under cost-of-service regulation. Future electric utility tariffs are estimated as a result of the simulation. The structure and level of future rates are configured to be efficient and equitable.

- The regulatory regime is the existing cost-of-service regulation currently used by the Commission. The current cost-of-service regulatory regime is assumed to continue over the study period.

- The financial structures of the utilities reflect future opportunities for earning a reasonable rate of return. A forecast of the rate case process can be developed through a review of the current and previous rate cases of the utilities. Future financial structures of the utilities are estimated as a result of the simulation.

42. Over the study period, the Status Quo Simulation is determined from the validity and stability of the results after repeated runs over the study period. Test simulations and calibrations are repeatedly performed until results are sensible and an appropriate status quo scenario has been identified and adopted over the study period.

43. As in the Baseline Simulation, hourly optimization models are used to analyze engineering and economic relationships, and an annual financial model is used to analyze utility financial planning issues. The Status Quo Simulation, however, runs across several years and consequently puts an emphasis on forecast values for load, fuel prices and supply, capacity additions and expenditures, and tariffs, among others. Results of the hourly models are aggregated for each study year and provide inputs for the annual models. Results of the annual models for each study year are then fed back to the hourly models. The hourly and annual models interact until equilibrium in each study year is achieved.

44. The optimal scale, timing, and location of investments in renewable power generation capacity for each study year are endogenously determined in the hourly simulation of the power market.

- Suggestions on the scale, timing, and location of alternative renewable power generation projects are gathered from utilities, the Commission, experts, stakeholders, trade publications, and the energy investment literature (see Part II). The output of the analysis is to identify candidate projects for renewable energy investments.

- The candidate projects for renewable energy investments are simulated in order to formulate a collection of least-cost expansion plans for renewable generation capacity over the study period. The objective of the simulation is to identify the optimal expansion plan that is consistent not only with the RPS but also with the encouragement of investments in renewable power generation.

45. The output of the Status Quo Simulation is a forecast of rate designs of electric utilities over the study period. It provides a meaningful analysis of future power market conditions in Hawaii, assuming the continuation of cost-of-service regulation.

46. The Commission welcomes comments on the various issues discussed above:

- Objective of the Status Quo Simulations;

- The choice of study period;

- Design of inputs;

- Candidate projects for renewable investments; and

- Forecast rate designs under the continuation of cost-of-service regulation.

D. Simulation of Alternative Scenarios: PBR Regimes

47. The objective of the Alternative Scenarios Simulation is to capture the operations of the power market of Hawaii over several years in the future, assuming the replacement of cost-of-service regulation with alternative regulatory regimes, such as PBR.

- The RPS, as before, is a minimum but hard constraint on the future share of renewable resources to total electricity supply.

- The profile and level of loads, as before, are the future consumption patterns of various customer classes.

- The structure and level of prices, as before, are the future rates for various customer classes and are configured to be efficient and equitable. However, under a particular PBR regime, such as a price cap, the electric utility rates may be pre-determined and consequently exogenous.

- The regulatory regime over the study period is a particular PBR regime (see Part III).

- The financial structures of the utilities, as before, reflect future opportunities for earning a reasonable rate of return.

48. Over the study period, the Alternative Scenarios Simulation, as before, is determined from the validity and stability of the results after repeated runs over the study period. Test simulations and calibrations are repeatedly performed until results are sensible and an appropriate set of alternative scenarios has been identified and adopted over the study period.

49. The interaction between the hourly models, the annual models, and the optimal expansion plans may be different in the Alternative Scenarios Simulation. For example, under price cap regulation, the electric utility rate is constrained to grow at a pre-determined rate. As a result, revenue in the future is largely a function of load, and profits typically depend on tight cost control. The impact of the price cap on profit is likely to determine capital expenditures that in the future directly affect the prospects of satisfying the RPS. The feedback between rates, profit, and investments is expected to be as diverse as the alternative regulatory regimes that are eventually considered in the simulation. Nevertheless, the optimal expansion plan under a particular PBR regime remains consistent with the RPS.

50. If, in satisfying the RPS, future rate designs have significant adverse effects on utilities' opportunity to earn a reasonable rate of return, then a variety of financial measures, such as a subsidy or monetary infusion, may be applied in order to preserve an opportunity for earning a reasonable rate of return. Financial measures are introduced only if the utility is adversely affected by the need to satisfy the RPS. Thus, the discounted present value of financial measures applied over the study period could be a fair estimate of the social cost of satisfying the RPS under a particular PBR regime.

51. In fulfilling the Commission's legislative mandate, the electric utility rate designs are formulated, among others, to enable and encourage the achievement of the RPS. In the future, however, if the utility actually falls short of the RPS for reasons other than the absence of cost efficacy in satisfying the RPS or the presence of circumstances that could not have been reasonably anticipated or ameliorated and remain beyond its control, then appropriate penalties may have to be determined and applied. The need for any penalty, and its nature, scope, and duration, are subject to further assessment as required on a case-by-case basis, if and when non-compliance occurs.

52. The output of the Alternative Scenarios Simulation is a forecast of rate designs over the study period. It provides a meaningful analysis of future power market conditions in Hawaii under a particular PBR regime. Several Alternative Scenarios Simulations may be performed depending on the number of alternative regulatory regimes considered in Part III.

53. The Commission welcomes comments on the various issues discussed above:

- Objective of the Alternative Scenarios Simulations;
- The choice of study period;
- Design of inputs;

- Candidate incentive or PBR regimes;
- Forecast rate designs under incentive or PBR regimes; and
- The nature, scope, and duration of penalties, if needed, for future non-compliance with the RPS.

V. Designing Electric Utility Rates in Hawaii

54. Candidate electric utility rate designs are evaluated through the Status Quo and Alternative Scenarios Simulations. Variations of estimated rate designs can be formulated through the incorporation of lessons drawn from current or best practices of RPS schemes (see Part II) and PBR regimes (see Part III). Candidate rate designs are evaluated according to their social welfare implications as well as their effects on efficiency and equity. Additional candidate rate designs may be estimated through further simulations as needed.

55. The output is an optimal electric utility rate design that is likely to maximize social welfare and to fulfill the Commission's legislative mandate. The optimal electric utility rate design resulting from the analysis is anticipated to enable the achievement of the RPS cost-effectively, encourage investments in renewable power generation in Hawaii, conform to existing or alternative regulatory regimes, such as PBR, and provide utilities with an opportunity to earn a reasonable rate of return through the rate case process.

56. In fulfilling the Commission's legislative mandate, the electric utility rate designs are formulated, among others, to enable and encourage the achievement of the RPS. The nature, scope, and duration of penalties, if needed, for any future non-compliance with the RPS, for reasons other than the absence of cost efficacy in satisfying the RPS or the presence of circumstances that could not have been reasonably anticipated or ameliorated and remain beyond the utility's control, are subject to further assessment as required on a case-by-case basis.

57. The end result of all the analysis discussed in this Initial Concept Paper is to create a document that forms the basis of a set of rules providing input to Commission's decisions on electric utility ratemaking as part of the rate case process in future.

58. The Commission welcomes comments on the various issues discussed above:

- Status Quo Simulations and electric utility rate design;
- Alternative Scenarios Simulations and electric utility rate design;
- Current or best practices of RPS schemes and PBR regimes and electric utility rate design;
- Candidate electric utility rate designs; and
- The nature, scope, and duration of penalties, if needed, for future non-compliance with the RPS.